Ageing and Conditioning Beer

- With Colin Kaminski
- Brewmaster – Downtown Joe’s Brewery
- Napa, CA
- Co-Author of Water – a Comprehensive Guide for Brewers
- Retired Designer at More Beer
Goals in Aging

- Settle for Clarity
- Link Proteins
- Round Flavors
- Do No Harm!
A walk through the Brewhouse

- Reductones
- Water
- HSA
- Malt Derived Polyphenols
  - Over Heating
  - Over Sparging
  - Over Milling
  - Transferring Grain to Boil
- Proteins
The Boil

- **Protein Coagulation**
  - Proper pH
- **Hop Derived Polyphenols**
  - Haze Formation
  - Tea Flavors
- **Cold Break**
  - Separation
Cooling and Oxygenation

- Oxygenating Trub
Fermentation

- Yeast Separation
- Avoid Non-Yeast Solids
Post Fermentation O2 Pickup

- Transferring
- Dead Legs
- Flushing Tanks, Kegs and Bottles
Fining

- Protien Haze
- Polyphenol Haze
- Imhoff Cones
- Stokes Law

Settling velocity is given by:

\[ v_s = \frac{2(\rho_p - \rho_f)}{9} \frac{g}{\mu} R^2 \]

- where \( v_s \) is the particle's settling velocity (m/s) (vertically downwards if \( \rho_p > \rho_f \), upwards if \( \rho_p < \rho_f \)),
- \( g \) is the gravitational acceleration (m/s²), \( \rho_p \) is the mass density of the particles (kg/m³), \( \rho_f \) is the mass density of the fluid (kg/m³) and
- \( \mu \) is the dynamic viscosity (kg/m²s).
# CO2 Pressure Chart

**CO₂ content in volumes based on the head pressure and temperature of the beer**

<table>
<thead>
<tr>
<th>temperature (°F)</th>
<th>head pressure (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>0.1</td>
</tr>
<tr>
<td>32</td>
<td>0.2</td>
</tr>
<tr>
<td>34</td>
<td>0.3</td>
</tr>
<tr>
<td>36</td>
<td>0.4</td>
</tr>
<tr>
<td>38</td>
<td>0.5</td>
</tr>
<tr>
<td>40</td>
<td>0.6</td>
</tr>
<tr>
<td>42</td>
<td>0.7</td>
</tr>
<tr>
<td>44</td>
<td>0.8</td>
</tr>
<tr>
<td>46</td>
<td>0.9</td>
</tr>
<tr>
<td>48</td>
<td>1.0</td>
</tr>
<tr>
<td>50</td>
<td>1.1</td>
</tr>
<tr>
<td>52</td>
<td>1.2</td>
</tr>
<tr>
<td>54</td>
<td>1.3</td>
</tr>
<tr>
<td>56</td>
<td>1.4</td>
</tr>
<tr>
<td>58</td>
<td>1.5</td>
</tr>
<tr>
<td>60</td>
<td>1.6</td>
</tr>
<tr>
<td>62</td>
<td>1.7</td>
</tr>
<tr>
<td>64</td>
<td>1.8</td>
</tr>
<tr>
<td>66</td>
<td>1.9</td>
</tr>
<tr>
<td>68</td>
<td>2.0</td>
</tr>
<tr>
<td>70</td>
<td>2.1</td>
</tr>
<tr>
<td>72</td>
<td>2.2</td>
</tr>
<tr>
<td>74</td>
<td>2.3</td>
</tr>
<tr>
<td>76</td>
<td>2.4</td>
</tr>
<tr>
<td>78</td>
<td>2.5</td>
</tr>
</tbody>
</table>

**Source style guidelines:** John Palmer (howtobrew.com)
CO2

- Force
  - *Surface Area*
  - *Overpressure*
- Stone
- Pinpoint
- Measuring CO2 Levels
Ageing

- **Benefits**
  - *Head Retention*
  - *Protiens*
  - *Clarification*
  - *Merging of Flavors including hop mellowing*

- **The Dark Side**
  - *Hop Fading*
  - *Staling*
  - *Biological Contaminants*
Barrel Ageing – Briefly

- Wood Flavor
- Other Soaked Flavors
- Micro Oxygenation
Bottling - *Briefly*

- Bottle Conditioning
- Counter Pressure
- Commercial
Thank You!

- Questions?